

CLAIMS

What is claimed is:

587-1

1 1. A light generator comprising:
2 a blue laser for generating a first beam of blue
3 light;
4 a first beamsplitter optically coupled to the blue
5 laser for splitting a second beam of blue light from the
6 first beam of blue light;
7 a second beamsplitter optically coupled to the first
8 beamsplitter for splitting a third beam of blue light
9 from the first beam of blue light;
10 a first upconversion laser optically coupled to the
11 second beamsplitter for generating a beam of green light
12 from the third beam of blue light; and
13 a second upconversion laser optically coupled to the
14 second beamsplitter for generating a beam of red light
15 from the first beam of blue light.

1 2. The light generator of Claim 1 wherein at
2 least one of the blue laser, the first upconversion
3 laser, and the second upconversion laser is a solid-state
4 laser.

1 3. The light generator of Claim 2 wherein each
2 of the first and second upconversion lasers comprises:
3 a laser gain element;
4 a focusing lens optically coupled to the laser gain
5 element for focusing blue light onto the laser gain
6 element;
7 an input coupler optically coupled to the focusing
8 lens for transmitting blue light and for reflecting red
9 light or green light; and
10 an output coupler optically coupled to the laser
11 gain element for totally reflecting light generated by
12 the laser gain element back to the laser gain element.

1 4. The light generator of Claim 3 wherein the
2 output coupler reflects pump energy that is not absorbed
3 by the laser gain element back to the laser gain element
4 to increase optical efficiency.

1 5. The light generator of Claim 3 wherein the
2 laser gain element is a Pr:YALO crystal.

1 6. The light generator of Claim 3 wherein the
2 input coupler is a plane mirror or a reflective coating
3 on an end face of the laser gain element adjacent to the
4 focusing lens.

1 7. The light generator of Claim 1 further
2 comprising a mirror optically coupled to the first
3 beamsplitter for directing the second beam of blue light
4 in a direction substantially parallel to the first beam
5 of blue light.

1 8. The light generator of Claim 1 further
2 comprising a mirror optically coupled to the second
3 beamsplitter for directing the third beam of blue light
4 in a direction substantially parallel to the first beam
5 of blue light.

1 9. The light generator of Claim 1 further
2 comprising at least one optical modulator to modulate at
3 least one of the second beam of blue light, the beam of
4 green light, and the beam of red light.

1 10. The light generator of Claim 1 further
2 comprising a wavelength selective device optically
3 coupled to the first beamsplitter, the first upconversion
4 laser, and the second upconversion laser for combining
5 the beam of red light, the beam of green light, and the

6 second beam of blue light into a single beam of combined
7 red, green, and blue light.

1 11. The light generator of Claim 10 wherein
2 the single beam of combined red, green, and blue light is
3 substantially white.

1 12. The light generator of Claim 10 wherein
2 the wavelength selective device is a prism or a
3 diffraction grating.

1 13. A light generator comprising:
2 a blue laser for generating a first beam of blue
3 light;
4 a first beamsplitter optically coupled to the blue
5 laser for splitting a second beam of blue light from the
6 first beam of blue light; and
7 an upconversion laser optically coupled to the first
8 beamsplitter for generating a beam of red light and a
9 beam of green light from the first beam of blue light.

1 14. The light generator of Claim 13 wherein at
2 least one of the blue laser and the upconversion laser is
3 a solid-state laser.

1 15. The light generator of Claim 14 wherein
2 the upconversion laser comprises:
3 a laser gain element for generating a beam of red
4 light and a beam of green light from the first beam of
5 blue light;
6 a focusing lens optically coupled to the laser gain
7 element for focusing the first beam of blue light onto
8 the laser gain element; and
9 an input coupler optically coupled to the focusing
10 lens for transmitting blue light and for reflecting red
11 and green light.

1 16. The light generator of Claim 15 wherein
2 the laser gain element is a Pr:YALO crystal.

1 17. The light generator of Claim 15 wherein
2 the input coupler comprises a plane mirror or a
3 reflective coating on an end face of the laser gain
4 element.

1 18. The light generator of Claim 13 wherein
2 the upconversion laser comprises a wavelength selective
3 element optically coupled to the laser gain element for
4 separating the beam of red light and the beam of green
5 light.

1 19. The light generator of Claim 18 further
2 comprising an output coupler optically coupled to the
3 laser gain element to partially reflect the beam of red
4 light or the beam of green light.

1 20. The light generator of Claim 19 further
2 comprising an optical modulator to modulate at least one
3 of the second beam of blue light, the beam of green
4 light, and the beam of red light.

1 21. A light generator comprising:
2 a blue laser for generating a first beam of blue
3 light and a second beam of blue light; and
4 an upconversion laser optically coupled to the blue
5 laser for generating a beam of red light and a beam of
6 green light from the first beam of blue light.

1 22. The light generator of Claim 21 wherein
2 the second beam of blue light, the beam of red light, and
3 the beam of green light are combined into a single
4 collinear beam.

1 23. The light generator of Claim 22 wherein
2 the single collinear beam is substantially white.

1 24. The light generator of Claim 21 wherein at
2 least one of the blue laser and the upconversion laser is
3 a solid-state laser.

1 25. The light generator of Claim 24 wherein
2 the upconversion laser comprises:
3 a laser gain element;
4 a focusing lens optically coupled to the laser gain
5 element for focusing blue light onto the laser gain
6 element;
7 an input coupler optically coupled to the focusing
8 lens for transmitting blue light and for reflecting red
9 and green light; and
10 an output coupler optically coupled to the laser
11 gain element for partially reflecting red and green light
12 and transmitting blue light.

1 26. The light generator of Claim 25 wherein
2 the input coupler comprises either a plane mirror or a
3 reflective coating on an end face of the laser gain
4 element.

1 27. The light generator of Claim 25 wherein
2 the laser gain element is a Pr:YALO crystal.

1 28. The light generator of Claim 25 wherein
2 the upconversion laser comprises a first wavelength
3 selective element optically coupled to the laser gain
4 element for separating the red light and the green light.

1 29. The light generator of Claim 28 wherein
2 the first wavelength selective element is either a prism
3 or a diffraction grating.

1 30. The light generator of Claim 28 wherein
2 the output coupler optically coupled to the first
3 wavelength selective element to partially reflect red
4 light or green light.

1 31. The light generator of Claim 30 wherein
2 the output coupler reflects blue light to increase
3 optical efficiency of the laser gain element.

1 32. The light generator of Claim 30 further
2 comprising a modulator to modulate at least one of the
3 second beam of blue light, the beam of green light, and
4 the beam of red light.

1 33. The light generator of Claim 30 wherein
2 the upconversion laser comprises a second wavelength
3 selective element optically coupled to the output coupler
4 for combining at least two of the beam of red light, the
5 beam of green light, and the beam of blue light into a
6 single beam of combined light.

1 34. The light generator of Claim 33 wherein
2 the single beam of combined light is substantially white.

1 35. A light generator comprising:
2 means for generating a first beam of blue light;
3 means for splitting a second beam of blue light from
4 the first beam of blue light;
5 means for splitting a third beam of blue light from
6 the first beam of blue light;
7 means for generating a beam of green light from the
8 third beam of blue light; and

9 means for generating a beam of red light from the
10 first beam of blue light.

1 36. The light generator of Claim 35 wherein at
2 least one of the means for generating is a solid-state
3 laser.

1 37. The light generator of Claim 36 wherein
2 each of the means for generating a beam of green light
3 and the means for generating a beam of red light
4 comprises:

5 a laser gain element;

6 means for focusing blue light onto the laser gain
7 element;

8 means for transmitting blue light and for reflecting
9 red light or green light produced by the laser gain
10 element; and

11 means for partially reflecting light generated by
12 the laser gain element back to the laser gain element.

1 38. The light generator of Claim 37 wherein
2 the means for partially reflecting light generated by the
3 laser gain element back to the laser gain element
4 reflects pump energy that is not absorbed by the laser
5 gain element back to the laser gain element to increase
6 optical efficiency.

1 39. The light generator of Claim 37 wherein
2 the laser gain element is a Pr:YALO crystal.

1 40. The light generator of Claim 37 wherein
2 the means for transmitting blue light and for reflecting
3 red light or green light produced by the laser gain
4 element is a plane mirror or a reflective coating on an
5 end face of the laser gain element adjacent to the
6 focusing lens.

1 41. The light generator of Claim 35 further
2 comprising means for directing the second beam of blue
3 light in a direction substantially parallel to the first
4 beam of blue light.

1 42. The light generator of Claim 35 further
2 comprising means for directing the third beam of blue
3 light in a direction substantially parallel to the first
4 beam of blue light.

1 43. The light generator of Claim 35 further
2 comprising means for modulating light optically coupled
3 to at least one of the second beam of blue light, the
4 beam of green light, and the beam of red light.

1 44. The light generator of Claim 35 further
2 comprising means for combining the beam of red light, the
3 beam of green light, and the second beam of blue light
4 into a single beam of combined red, green, and blue
5 light.

1 45. The light generator of Claim 44 wherein
2 the single beam of combined red, green, and blue light is
3 substantially white.

1 46. The light generator of Claim 44 wherein
2 the means for combining is a prism or a diffraction
3 grating.

1 47. A light generator comprising:
2 means for generating a first beam of blue light;
3 means for splitting a second beam of blue light from
4 the first beam of blue light; and
5 means for generating a beam of red light and a beam
6 of green light from the first beam of blue light.

1 48. The light generator of Claim 47 wherein at
2 least one of the means for generating is a solid-state
3 laser.

1 49. The light generator of Claim 48 wherein
2 the means for generating a beam of red light and a beam
3 of green light from the first beam of blue light
4 comprises:
5 a laser gain element;
6 means for focusing the first beam of blue light onto
7 the laser gain element; and
8 means for transmitting blue light and for reflecting
9 red and green light produced by the laser gain element.

1 50. The light generator of Claim 49 wherein
2 the laser gain element is a Pr:YALO crystal.

1 51. The light generator of Claim 49 wherein
2 the means for transmitting comprises a plane mirror or a
3 reflective coating on an end face of the laser gain
4 element.

1 52. The light generator of Claim 47 wherein
2 the means for generating a beam of red light and a beam
3 of green light comprises means for separating the beam of
4 red light and the beam of green light.

1 53. The light generator of Claim 52 further
2 comprising means for partially reflecting the beam of red
3 light or the beam of green light.

1 54. The light generator of Claim 53 further
2 comprising means for modulating at least one of the
3 second beam of blue light, the beam of green light, and
4 the beam of red light.

2217

1 55. A light generator comprising:
2 means for generating a first beam of blue light and
3 a second beam of blue light; and
4 means for generating a beam of red light and a beam
5 of green light from the first beam of blue light.

1 56. The light generator of Claim 55 wherein
2 the second beam of blue light, the beam of red light, and
3 the beam of green light are combined into a single
4 collinear beam.

1 57. The light generator of Claim 56 wherein
2 the single collinear beam is substantially white.

1 58. The light generator of Claim 55 wherein at
2 least one of the means for generating is a solid-state
3 laser.

1 59. The light generator of Claim 58 wherein
2 the means for generating comprises:
3 a laser gain element;
4 means for focusing blue light onto the laser gain
5 element;
6 means for transmitting the blue light and for
7 reflecting red and green light produced by the laser gain
8 element; and
9 means for partially reflecting the red and green
10 light produced by the laser gain element and for
11 transmitting blue light.

1 60. The light generator of Claim 59 wherein
2 the means for transmitting comprises either a plane
3 mirror or a reflective coating on an end face of the
4 laser gain element.

1 61. The light generator of Claim 59 wherein
2 the laser gain element is a Pr:YALO crystal.

1 62. The light generator of Claim 59 wherein
2 the means for generating a beam of red light and a beam
3 of green light from the first beam of blue light
4 comprises means for separating the red light and the
5 green light.

1 63. The light generator of Claim 62 wherein
2 the means for separating the red light and the green
3 light is either a prism or a diffraction grating.

1 64. The light generator of Claim 59 wherein
2 the means for partially reflecting the red and green
3 light produced by the laser gain element and for
4 transmitting blue light is optically coupled to the means
5 for separating the red light and the green light to
6 partially reflect only one of the red light or the green
7 light.

1 65. The light generator of Claim 64 wherein
2 the means for partially reflecting the red and green
3 light produced by the laser gain element and for
4 transmitting blue light reflects blue light to increase
5 optical efficiency of the laser gain element.

1 66. The light generator of Claim 64 further
2 comprising means for modulating at least one of the
3 second beam of blue light, the beam of green light, and
4 the beam of red light.

1 67. The light generator of Claim 64 wherein
2 the means for generating a beam of red light and a beam
3 of green light comprises means for combining at least two
4 of the beam of red light, the beam of green light, and

5 the beam of blue light into a single beam of combined
6 light.

1 68. The light generator of Claim 67 wherein
2 the single beam of combined light is substantially white.

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